Space Weather Technical Forecast

Issued on Tuesday, 09 July 2024 at 13:05 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Slight chance of M-class flares (R1-R2; Minor-Moderate radio blackouts) throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate with a solitary M-class flare reaching M1.1 at 08/1241 UTC from a region close to the southeast limb. There are seven sunspot regions on the disc. AR3738 (Eki/Beta-Gamma) in the southeast remains the largest and most complex region on the disc with minor changes noted in the size and consolidation of its main lead and trailer spots. The remaining regions on the disc appear small, magnetically simple. Of particular note are returning Ex-AR3712 and Ex-AR3713 in the southeast disc. The latter appears to have the greater number of spots and magnetic complexity associated with it, however confidence in classification of both regions will improve they rotate further onto the visible disc. No Earth-directed Coronal Mass Ejections (CMEs) have been observed during the past 24 hours.

Solar Wind / Geomagnetic Activity: Solar winds as observed by ACE at L1 peaked at slightly elevated levels of 438 km/s at 08/1455 UTC possibly as a result of a weak connection to CH49/+ in the northwest. Since then, solar winds have been on a slow decline back to current slow-ambient levels of around 370 km/s. The density was near or below average. The Interplanetary Magnetic Field, Bt, was largely weak, but started at near moderate levels until 08/1250 UTC, at around 8nT. The north-south component, Bz, varied weakly between +5/-5nT. The phi angle was very variable with a slight bias towards positive (away from the Sun). The resulting geomagnetic activity was Quiet to Unsettled (Kp1-3).

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux observed by GOES18 remained at background levels. High energy electron flux (greater than 2MeV) observed by GOES16 was at background levels. The 24-hour fluence was below Active, with 2.22e6 integrated pfu observed at 09/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be at Low to Moderate levels, with isolated M-class flares likely and a slight chance of activity becoming High, due to any isolated X-class flares. Flare risks will be revised as the new regions in the far southeast rotate into clearer view on the visible disc in the coming days.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs feature in the current forecast. The solar wind starting at slow-ambient to slightly elevated levels on day 1 (10 Jul), owing to minor fast wind influences from a coronal hole in the northwest disc. Two moderately sized coronal holes in the southwest disc could produce elevated solar winds between days 2-4 (10-12 Jul). However, any geomagnetic response from either, or both of these two coronal holes is likely to be muted due to Earth's proximity to the solstice.
Geomagnetic activity is expected to be mainly Quiet to Unsettled (Kp0-3) through the period, but

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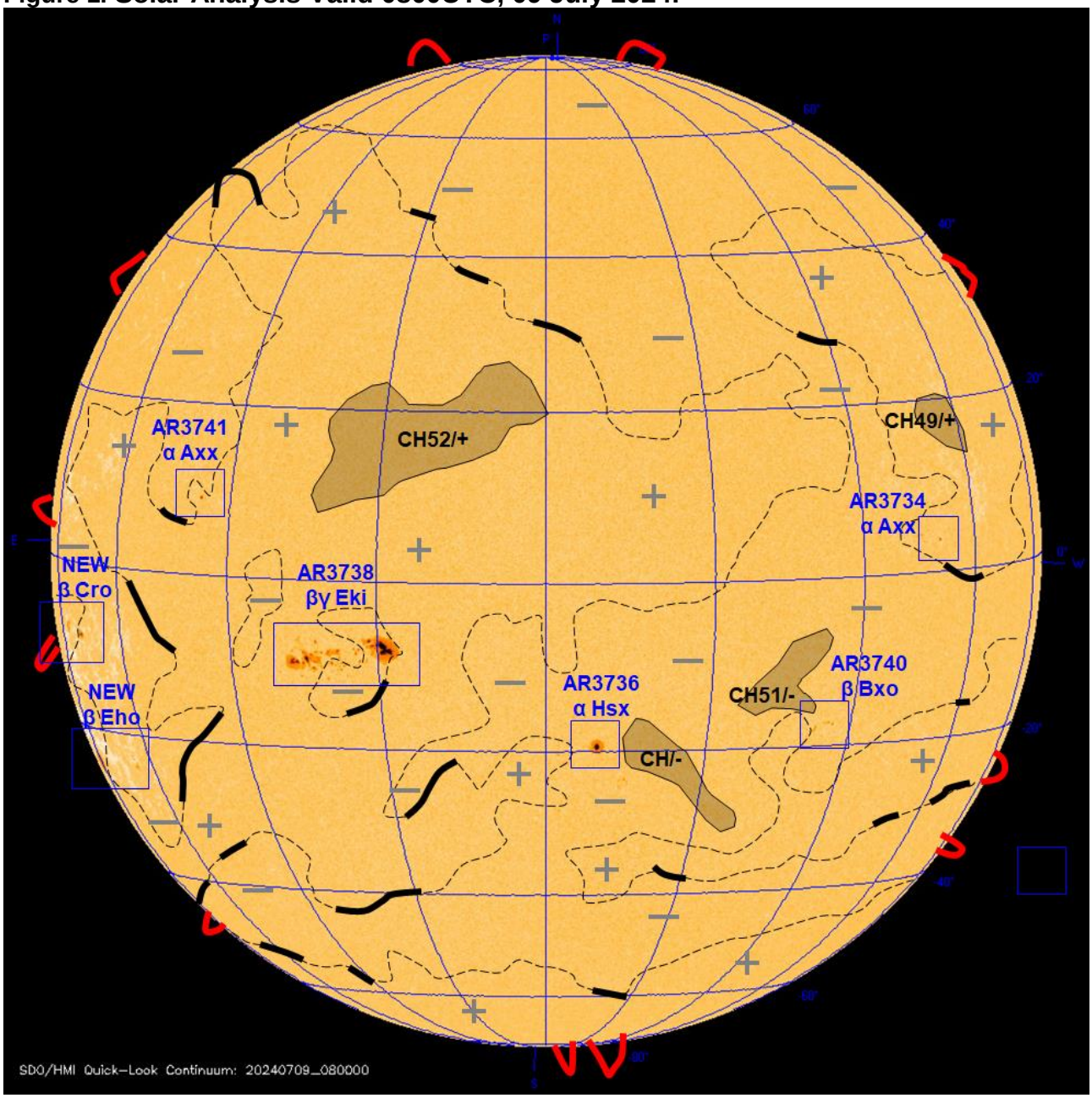
with a chance of isolated Active (Kp4) intervals on days 2 and 3 (10 and 11 Jul) due to anticipated fast wind influence.

Energetic Particles / Solar Radiation: Solar radiation storms are not expected, but there is a very slight chance of reaching S1/Minor Radiation Storm or greater levels. This risk increases a little later in the period as AR3738, currently in the southeast, rotates towards centre disc and into a more geoeffective position.
High energy electron flux is expected to remain mostly at background levels through this period, with the Active (1e8 integrated pfu) fluence threshold not expected to be reached.

Figure 1. Solar Analysis Valid 0800UTC, 09 July 2024.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

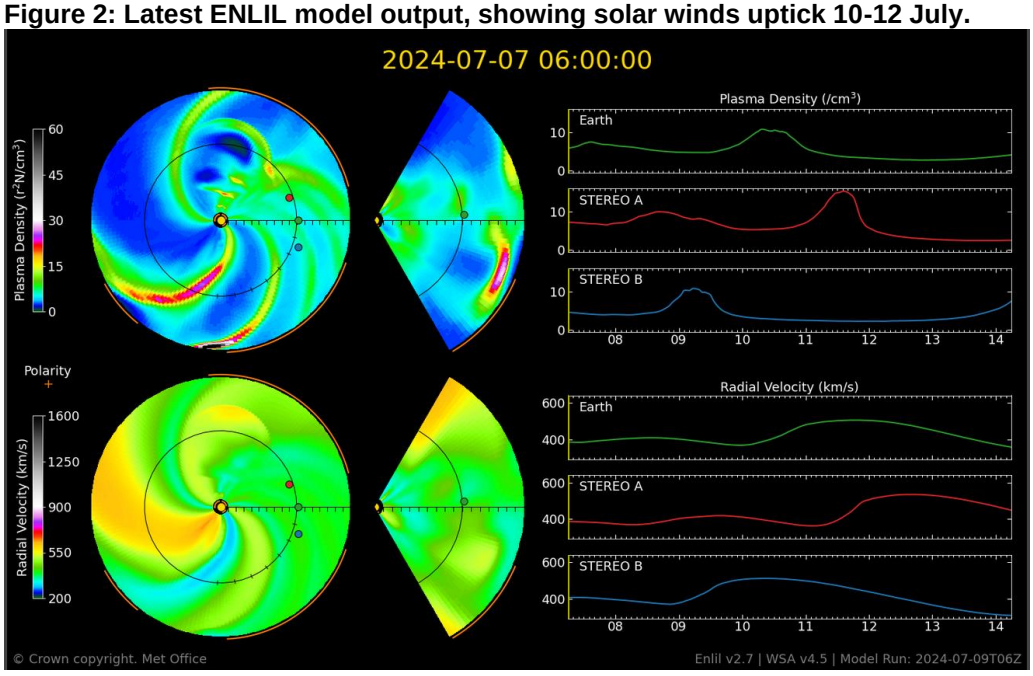
No anticipated Earth-directed CMEs feature in the forecast.
The solar wind is most likely to be at slow-ambient levels on day 1 (09 Jun), though perhaps with minor influence from CH49/+ in the northwest that could briefly raise levels to slightly elevated at around 400km/s. Two moderately sized negative coronal holes in the southwest disc could give elevated levels between days 2 and 4 (10-12 Jul). Located at low latitudes in the southern hemisphere they could bring faster winds to Earth, however, significant geomagnetic response is considered unlikely from either of the two coronal holes in the southwest disc due to Earth's proximity to the solstice.
Geomagnetic activity is expected to be mainly Quiet to Unsettled through the period, but with a chance of isolated Active intervals, especially during days 2 and 3 (10 and 11 Jul) due to anticipated fast wind influence.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	5	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

Figure 2: Latest ENLIL model output, showing solar winds uptick 10-12 July.



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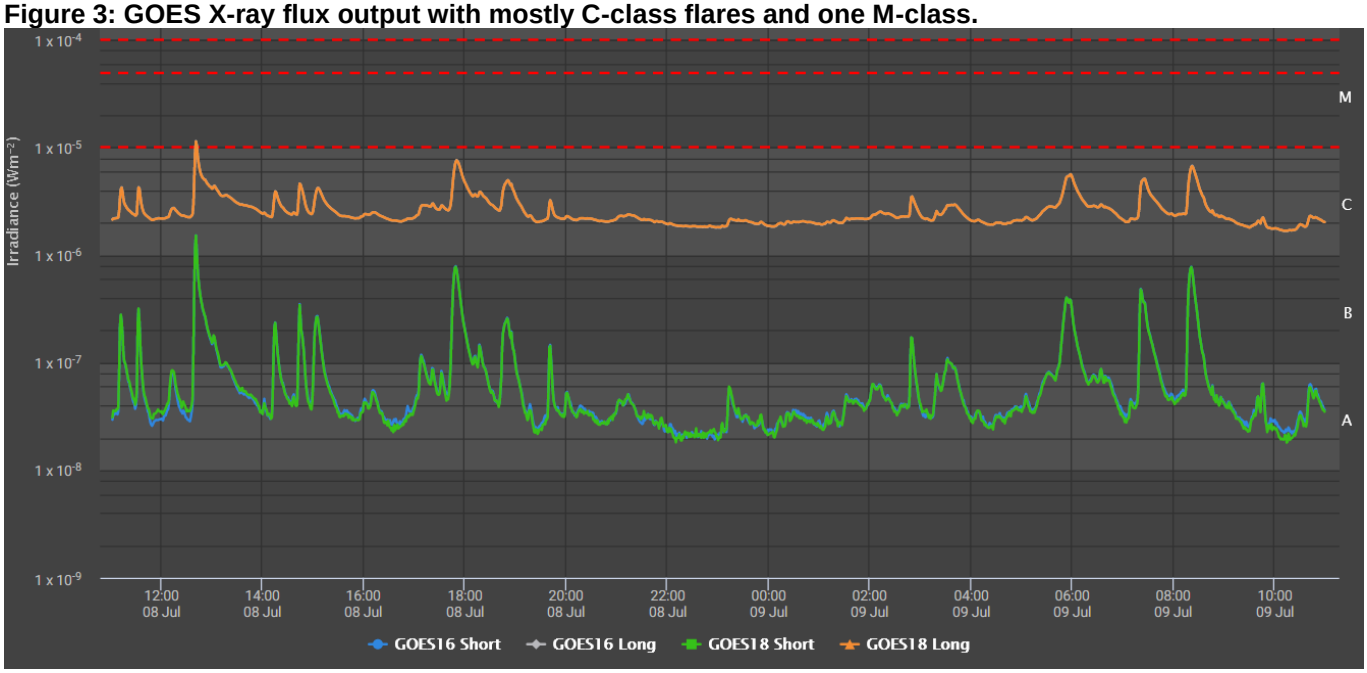
Radio Blackouts - X-Ray Flares:

Solar activity has been Moderate with a solitary, low-level M-class flare, measuring M1.1 observed at 08/1246 UTC from a region close to the southeast limb. SDO imagery shows a considerable amount of magnetic looping above the Sun's surface in this area. There are seven active regions on the disc with AR3738 (Eki/Beta-Gamma) in the southeast the largest and most complex region on the disc. Although there has been some modest increase in overall size of the sunspot group, there has also been spreading of the intermediate spots, with consolidation around the main lead and trailer regions. The remaining regions on the disc appear small and magnetically simple, however, the returning Ex-AR3712 and Ex-AR3713 near the southeast limb are now included and have been recently numbered by SWPC. The latter appears to have the greater number of spots and magnetic complexity associated with it, however confidence in the classification of both regions will improve as they rotate further into view on the visible disc. Solar activity is expected to be Low to Moderate, with isolated M-class flares likely and a very slight chance of activity increasing to High levels resulting from a risk of isolated X-class flares. Flare risks may be revised as the new regions in the far southeast rotate into clearer view on the visible disc in the coming days.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	Yes	50	50	50	50
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 3: GOES X-ray flux output with mostly C-class flares and one M-class.



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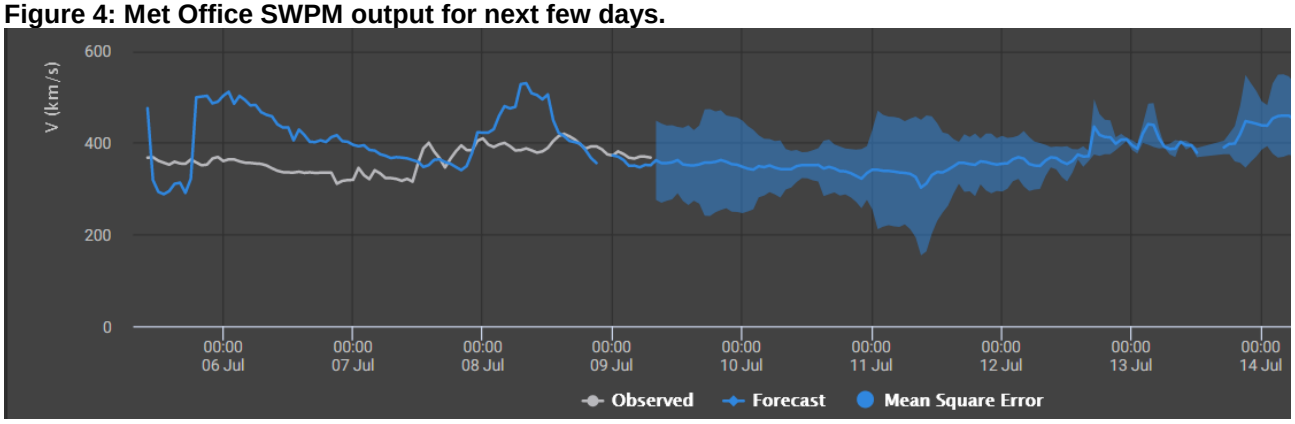
Solar Radiation Storms - (High Energy Protons):
High energy proton flux at GOES18 is at background levels. It is most likely to remain that way, but with a very slight chance of exceeding the S1/Minor radiation storm threshold should any larger flares occur, mainly from AR3738. Considering the region still resides in the southeast disc, it is still in an unfavourable location for significant proton enhancements to be detected at Earth following any notable flares. As the region rotates more towards the centre disc by day 3 (11 Jul), the probability of exceeding S1 increases slightly, but still remains very low.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	10	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: Met Office SWPM output for next few days.



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High Energy Electrons Event (≥ 2MeV):

High energy electron flux recorded at GOES16 has been at background levels and is expected to remain that way through the forecast period, with no notable geomagnetic enhancements anticipated that would significantly affect the Van Allen belts. MOSWOC REFM output is considered good guidance, with a generally flat trend indicated through the period, well below the Active 1e8 integrated flux threshold.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 5: High energy electron flux at GEO and Met Office REFM output showing little overall change.

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